12

SUPPLEMENT

TO THE

SORGHO AND IMPHEE.

The history of the Sorgho in this country, from the first exhibition by Mr. Peters of his syrup at the Fair of the United States Agricultural Society in 1856, to the gratifying success of Mr. Joseph S. Lovering, in producing Sorgho sugar of all qualities, and their exhibition before the same society January 13th, 1858, is fraught with interest to the American public. This society has conferred appropriate honors upon the two men who have been especially instrumental in popularizing the Sorgho in the United States; first, by bestowing its diploma upon Mr. Peters, and second, by awarding its large silver medal to Mr. Lovering. As the matter has assumed historical interest, it will perhaps be as well to transcribe from the minutes so much of the proceedings as relates to the subject:

"The Chair next read a letter from Mr. Joseph S. Lovering, a sugar refiner of Philadelphia, advising the society of the shipment to them by him of several boxes of sugar made from the Sorgho, or Chinese sugar cane; as also some pamphlets embodying the manner and results of the experiments.

"Mr. Olcott, of New York, stated that he had seen and carefully examined the samples referred to, and had studied the pamphlet that morning, and congratulated the society that at last the fact was established that excellent sugar could be made in the Northern States in large quantity, and at a moderate price. Mr. Lovering had cut the Gordian knot, and done it in so thorough and scientific a manner,

that there was no longer room for a doubt. He claimed that Mr. L. had earned the thanks of the farmers of America, and as this society was the representative of its agricultural interests, he should move that the large silver medal of the society be conferred upon Joseph S. Lovering.

"Senator Harlan, of Iowa, moved the reference of the matter to a Special Committee, and this being seconded, the Chair appointed as such committee Messrs. D. Jay Browne, of the Patent Office, Simon Brown, of Massachusetts, and Olcott, of New York.

"The committee retired for consultation, and after a season reported as follows:

"'The committee appointed to consider the propriety of awarding the large silver medal of the society to Mr. Joseph S. Lovering, of Philadelphia, respectfully report that, having examined the specimens of sugar presented by him, and the scientific examinations set forth in his published pamphlet, they recommend that the medal be awarded to Mr. Lovering, for the care with which his experiments have been made, and the sample presented; but your committee do not wish to be understood as certifying that the manufacture of sugar is as yet demonstrated to be more profitable than other crops.

'SIMON BROWN, *Chairman.*'

"This report was adopted."

It must by no means be inferred that Mr. Lovering is the *first* person who has made sugar of good quality from the Sorgho. Two or three years ago this was accomplished by Professor Avequin, of New Orleans, as will be seen from an article from the *Bee* in another part of this Appendix. In addition to these, Professors C. T. Jackson and A. A. Hayes, of Boston, have both made it in small quantity, and reports have been published during the past season of sugar making by a great number of persons; but Mr. Lovering is entitled to especial honor because his experiments were conducted in a manner so intelligent, careful, and satisfactory; his results have been so cheering and of such an available character, and so clearly demonstrate the practicability of making sugar throughout the most northern portions of the Temperate Zone. Mr. Lovering's pamphlet will be found in this Appendix, as well as further practical directions to farmers based upon his successful process.

Judge J. D. Cator, of Ottawa, Illinois, has published an interesting account of his experiments and successful sugar making. The sugar

he made is stated to be of good quality, but the quantity per acre could not be practically demonstrated, because the amount produced was on too small a scale to afford a useful basis for computation. This has been the case in most of the instances reported, and the mere production of these small quantities of sugar is useful only as corroborating the fact of its existence in the juice. Now that it has been proved beyond the shade of a doubt that sugar can be made from Sorgho and Imphee, and that in large quantities; of course this branch of industry will be undertaken with greater or less profit, according to existing conditions. Sugar may be a profitable crop in districts far removed from the seaboard or from the great lines of transport; but there should be a careful scrutiny of many possible contingencies before capital is extensively employed in this way.

If, however, it is a mooted question whether we should grow the new canes for a sugar crop, it is much less questionable if, in almost any locality, they would not be very remunerative as a source of alcohol. In this case, all that is necessary is to have command of any desired amount of fuel, either wood or coal, and then the nearer the seaboard. or to large cities of the interior, the farm may lie, the more certain will the cultivator be to have a profit from his crop. The cold rainy seasons which injure the secretion of cane sugar in the stalk, operate rather favorably than otherwise for the production of alcohol. The sugar in the stalks will be in large proportion glucose, and thus one step in its transformation towards alcohol is saved, for cane sugar must change into glucose before it can pass into the alcoholic fermentation.

To afford some idea of the range of latitude in which the Sorgho will grow, the effects of manures and soils upon the height of stalk, the varying time required in different localities to complete its growth, and the height and diameter of stalk, I give the following tabular statement from the *American Agriculturist*, of returns made to that paper during the present season.

CONDENSED REPORTS OF EXPERIMENTS

WITH THE CHINESE SUGAR CANE.

Name of Experimenter.	State.	County.	Latitude.	Soil.	Manure.	Planted at about	Headed out about	Height at time of heading.	About the time of ripening.	Height at time of ripening.	Diam'ter 1 foot from ground.
								feet.		feet.	inch
1 Wm. Wanzer...	Ct...	Litchfield..	41⅜	Sandy loam.....	None.....	May 25	Sept. 1	9	Killed Sept. 30	12	1
2 Wm. Crocker...	N.Y.	Erie	43	Sandy loam.....	Plaster.....	May 20	Sept. 24	7	Killed Oct. 1		
3 T. R. Joynes, jr.	Va .	Accomac...	38	Sandy loam.....	None.....	April 7	Aug. 15	10	Ripe Sept. 15	14	1⅛
4 Wm. J. Tracy..	R. I.	Providence	41⅜	Light sandy loam	Hog yard.....	May 20	Aug. 30		Killed Sept. 29	8¼	⅝
5 H. Williamson..	Pa..	Chester....	40	Slate, porous....	None.....	May 9		10	Ripe Oct. 15	12	1
6 Hubert Greaves.	Ohio	Sandusky..	41⅛	Rich black loam.	None.....	June 15	Sept. 12	12		13	2
7 William Chase..	R. I.	Providence	41⅜	Sandy loam.....	Stable	May 15	Aug. 31	12	Ripe Oct. 15	13	1
8 A. W. Russell...	N.Y.	St. Law'ce.	44½	Sandy	Barn-y'd & ashes	May 29	Oct. 5	8½			1¼
9 J. Selden.....	Pa..	Pike.....	41⅛	Sandy gravel....	Sod-leach'd ashes	June 5	Sept. 17		Killed Sept. 29	10	1⅛
10 J. Selden.....	Pa..	Pike.....	41⅛	Damp loam	None-old garden	June 1	Sept. 18		Killed Sept. 29	10½	1¼
11 Dan'l Colklesser.	Me .	Wash'ton .	39⅛	Sand, rubbish ...	None.....	May 15	Aug. 15		Ripe Sept. 25	12⅜	1½
12 Alfred H. Brown	Mass	Worcester.	42⅜	Rich garden loam	Stable, ash. & plas	May 26	Sept. 20	5½	Killed Sept. 30		⅞
13 C. P. Vaneil. ...	Ill...	Sangamon.	40	Black loam.....	Noue	May 16		10	Ripe Sept. 14	11	1¼
14 S. Sayer.....	Ohio	Coshocton.	49⅛	Sandy loam.....	A little barn-yard	May 15		10	Ripe Sept. 15	12	1⅛
15 Dr. S. S. Keene.	R. I.	Providence	42	Clay loam	Barn-yard						
16 John A. Bunce..	Wis.	Juneau ...	43½	Sandy loam.....	None—new land	May 22	Sept. 6	10	Cut Sept. 29	11	1⅛
17 R. Cramer.....	Ill...	Mercer....	41¼	Sandy loam.....	None.....	May 27			Oct. 12	12	1⅛
18 A. B. Price.....	Ind..	Porter....	41½	Sandy loam, rich.	None.....	May 23		9	Ripe Oct 15	11	
19 O. M. Colkins...	Ind..	Spencer ...	38	Sandy loam.....	None-old fence..	May 12	Aug. 28	11¼	Ripe Sept. 24	14⅛	1⅛
20 S. C. Pruden....	Iowa	Van Buren	40⅞	Prairie loam.....		M. 1-J. 1			Ripe Oct. 12	12½	1½
21 John Fraizer....	Ohio	Clinton....	39⅛	Clay bank.....	Old barn-yard...	June 14		10	Ripe Sept. 20	15	1½
22 S. M. Berry.....	Ky..	Scott.....	38	Clay soil.....	None.....	April 30	Aug. 10		Ripe Oct. 1	14	1¼
23 Wm. Kerr.....	Ohio	Brown.....	39	Light sandy soil..	None.....	May 15	Sept. 15		Ripe Oct. 1	12	

24 Z. Beesan	Ind..	White.....	41⅝	Sandy loam.....	None.....	May 20	Sept. 1	11	Ripe Oct. 15	14	1½
25 S. Williams	N.Y.	Seneca.. ..	43¼	Clay.....		May 10	Aug. 24		Killed Oct. 15	13	1⅛
26 Alf. S. Whidden	N.H.	Stafford...	43¼	Good garden.....	None	May 15	Sept. 15	12	Killed Oct. 5		1¼
27 Hiram Wilson..	C.W.		43	Light sandy loam	Slightly	May 20	Sept. 1			12	1¼
28 John Crapo. ...	Iowa	Benton	42½	Dark sand gravel	Coarse stable....	May 18	Sept. 1	11½	Ripe Oct. 16	13½	1½
29 Thad. Pomeroy.	N.Y.	Onondaga.	42⅝	Sand loam		June 1]			Cut Oct. 14	14	1¼
30 S. S. Moser. ...	Ohio	Trumbull..	41½	Black loam.....	None.....	May 25	Sept. 15	9	Ripe Oct. 30	11	1¼
31 G. Engle & Co..	Pa..	Beaver ...	40⅞	Clay loam.....	Comp. leaf mold.	May 20			Ripe Oct. 19	10	1⅛
32 Geo. W. Wilson.	Ill...	Cook.....	41½	Clay loam.....	None.....	June 8	Sept. 10	9]	Blo. d'n Oct. 15	11	1
33 L. Eastwood	Ohio	Lucas	41⅝	Sandy loam.	None	May 27	Sept. 6	10	Ripe Oct. 15	14	1½
34 J. S. Woodward	N.Y.	Niagara....	43	Coarse gravel....	Barn-yard.....	May 28	Sept. 15	10	Ripe Oct. 15	13	1⅜
35 Fred'c P. Bissell	Ct .	Tolland....	41¾	Sandy loam.....	None	May 25	Sept. 10	12		14	1 .
36 S. S. Thompson..	N. J.	Salem.....	39½	Sandy loam.....	A little barn-yard	May 7	Aug. 15	9	Ripe Sept. 15	12	1½
37 S. H. Jenks	Mich	Ionia	43	Sandy gravel....	None	May 26	Sept. 1	9	Killed Oct. 22	11	1⅛
38 S. W. Martin ...	N.Y.	Alleghany..	42½	Sandy loam.....	Poult. droppings.	May 26	Sept. 12			12	
39 T. Cather	Va .	Taylor.	39½			May 23		10	Ripe Oct. 2	12	
40 A G. Weed ..	Iowa	Howard...	43½	Good prairie.....	None.....	May 19	Sept. 15	10	Killed Sept. 28		
41 Joseph Troth...	Iowa	Linn	42	Sandy	None.....	May 10			Ripe Oct. 4	13	1⅜
42 J. N. Weaver....	Tenn	Henry.....	36½	Clay loam.....	Barn-yard.....	May 10	Aug. 15	9	Ripe Sept. 18	13	1½
43 James Pott ...	Pa..	Fulton.....	40	Slate soil.....	None.....	May 15			Ripe Sept. 30	12	1½
44 H. G. Huling ...	Ill. .	Lasalle. ...	41½	Black loam.. ..	None.....	May 21	Sept. 1	9	Ripe Oct. 10	11	1
45 Almond Foster..	nd.	Lake.....	41½	Black sandy loam		June 1					
46 J. B Hungerford	Ohio	Lake	41⅞	Clay loam.....	Barn-yard.....	May 26			Killed Oct. 20	10	1
47 Milton Stebbins.	Mass	Hampden..	42	Sandy	Barn-yard.....	May 15		10	Killed Sept. 29	12	1⅛
48 John Dexter	Ct...	Windham..	41⅞	Sandy loam	None..	May 13	Sept. 0	10	Killed Sept. 29	11	1
49 J. L. Stephens..	Me .	Hancock...	44½	Good garden....	Old barn-yard ...	May 16	Sept. 15	9	Killed Oct. 22	9½	1
50 John Brown ..	Ind.	Harrison...	38¼	Sandy loam.....	Barn-yard.....	May 15	Aug. 15	10	Ripe Sept. 20	13	1⅜
51 A. McClelland .	Ohio	Holmes ...	40½	Clay loam.....	None	May 21			Killed Oct. 19	12	1⅛
52 Charles M. Keep	Mich	Calhoun...	42¼	Clay loam.....	Stable and ashes.	May 23	Sept. 5	9	Ripe Oct. 18	11	
53 E. W. White ..	N.Y.	St. Law'ce.	44½	Garden loam.....	Barn-yard.....	May 25	Aug. 25	10	Ripe Oct. 31	13	1¼
54 H. G Ainsworth	Ill ..	McLean....	40½	Sandy loam.....		May 25	Aug. 20	10	Ripe Sept 25	13	2
55 D. B. Simmons..	Ohio	Medina ...	41	Stiff clay	Barn-yard.....	May 21	Sept. 3	10½	Ripe Oct. 15	12	1⅛
56 F. A. Fleming..	Pa..	Clearfield..	41	Sandy loam.....	Hen manure& ash	June 3	Sept. 14	7½	Killed Oct. 20	8	1½
57 Geo. R. Pelton..	Ohio	Trumbull..	41½	Loam.....		May 27	Sept. 15		Ripe Oct. 15		
58 J. McRorie	N.Y.	Wayne. ..			Barn yard	May 13		9	Killed Oct. 20	10	1

J. S. LOVERING'S EXPERIMENTS.

A DETAILED ACCOUNT *of Experiments and Observations upon the Sorghum Saccharatum, or Chinese Sugar Cane, made with the view of determining its value as a sugar-producing plant, from September 28, to December 20, 1857, at Oakhill, Philadelphia County, Pa.* By JOSEPH S. LOVERING.

THE introduction of this plant into the United States, and the hope of producing sugar from it at the North, profitably, have excited such universal interest, that it has this year been planted in almost every State in the Union; and as the season has advanced, the opinions early expressed by many intelligent and scientific experimentalists, that it contains no crystallizable sugar, have apparently been confirmed by later trials. A few crystals, it is true, have been obtained in one or two instances, but all hope of producing sugar from it profitably seems to have been abandoned.

My object in making the following experiments has been to throw what light I could upon this important question, and, in the event of the result proving favorable, to give such a formula as would enable the uninitiated to proceed with confidence of success. They have been pursued without any attempt at extraordinary production, either in the cultivation of the cane or the development of its properties; on the contrary, the experiments were made upon small quantities, under many disadvantages that would not occur in large operations, and consequently with results less favorable.

The series being completed, perhaps the best method of communicating the results and imparting the knowledge obtained to the public, will be by giving the following extracts from my notes, made as the work proceeded. They will show the progress of the development of the sugar in the stalk, and its decline, with many other interesting facts.

EXTRACTS.

On the 10th of May I planted about half an acre, on upland of good quality, such as would yield, in ordinary seasons, fifty to sixty bushels Indian corn to the acre. The rows four feet apart, and the plants intended to be six inches apart in the rows, but which, on taking off the

crop, proved to be a little over seven inches apart. When the canes were about eighteen inches in height, I had the suckers removed. During the month of June I passed the hoe-harrow through it twice, a man following with the hand-hoe, as in the case of Indian corn. It was then left to take care of itself. It grew rapidly and evenly, and attained the height of twelve to fourteen feet.

My apparatus and utensils for conducting the experiments consisted of the following, viz. :

A pair of iron rollers, seven inches diameter and twelve inches long, set in a frame one eighth of an inch apart, with spout to catch and collect the juice, and a crank turned by hand ; a few sugar moulds and pots ; some ivory black or animal carbon ; two filters, made of common bed ticking, in the shape of an elongated pudding bag ; a thermometer, Beaumé's Pesè-Sirop or saccharometer, and a polariscope. All the other utensils I obtained from the kitchen, viz. ; a copper kettle of ten gallons capacity, a ladle, some tin pans, bowls, buckets, &c., to contain the juice.

FIRST POLARISCOPIC OBSERVATION.

Sept. 28.
Temperature, noon, 71° F.
Wind S. W.
Clear.

Of two canes took the first joints above the stay roots—

1st joint, 9 inches long, weighed - - - - - - - -	118.854	grammes.
2d " 8 " " " - - - - - - - -	93.742	"
Weight of 1st joints of two canes, - - - - - - -	212.596	"
After passing these three times through the rollers, the bagasse weighed - - - - - - - - - - - -	64.380	"
Leaving, as weight of juice, (69.7 per cent.,) - - - -	148.216	"

Measured the juice, and found 135 fluid grammes—specific gravity, 1 063

After precipitation by basic acetate of lead, of a voluminous green colored flocculent substance, it filtered with difficulty, then completed the decolorization by passing it through animal carbon, and found by first observation in polariscope,

A deflection of the ray, right,	27°		
Add 10 per cent. for dilution by precipitant	2°.7		29.7 right.
After inversion by H.Cl. left	12°.0		
Add 10 per cent. as above,	1°.2	temperature 27°,	13.2 left.
Sum of inversion,			42.9

This sum of inversion, (42°.9) at temperature 27°, indicates 54.35 grammes of pure dry sugar to the litre of juice, and by reference to past results it is found that 204.24 grammes of sugar per litre, equal 18.82 grammes per 100, or 18.82 per cent. Then, as 204.24 : 18.82 :: 54.35 : 5.008 per cent. of sugar in the juice, and as 100 : 5.008 :: 69.7 : 3.49 per cent. of sugar in the cane. A second observation in polariscope, of the juice from the two joints of the same canes next above these, indicated 5.57 per cent. of sugar in the juice, proving them to be richer than those nearer the ground.

FIRST PRACTICAL EXPERIMENT.

Sept. 30. Temp. 8 A. M. 40°, M. 66°.

The fact of the presence of crystallizable sugar in the cane being established, I proceeded to cut and grind twenty feet of a row, and passed the thirty canes which it produced three times through the rollers; about one fourth of the seed had changed to a dark glistening brown color, but was still milky; the remainder was quite green; ground six to eight of the lower joints, which together yielded three and a half gallons of juice, weighing 9° Beaumé; neutralized the free acid by adding milk of lime; clarified with eggs and boiled it down to 240° Fahrenheit.

This first experiment looked discouraging and unpromising at every step; its product was a very dark, thick, viscid mass, apparently a caput mortuum; it stood six days without the sign of a crystal, when it was placed over a flue and kept warm four days longer, when I found a pretty good crop of soft crystals, the whole very similar to the "Melada," obtained from Cuba, but of darker color.

SECOND EXPERIMENT.

Oct. 13, Temp. 8 A. M. 50°, M. 72°. S. E. cloudy.

About two weeks having elapsed since the first experiment, the weather in the interim having been quite warm, temperature at 8 A. M. 40° to 52°, and at noon 66° to 75° Fahrenheit; and about one half the seed being ripe, I determined to try it again, but not being very sanguine of success, no polariscopic observation was taken.

Cut and ground fifty feet of a row, which produced eighty-eight canes, and yielded eight gallons of juice, weighing 10° Beaumé (one

degree more than the previous cutting), from the six and seven lower joints; juice slightly acid. First clarification four and three quarter gallons, neutralized with three tablespoonsful of milk of lime, stirred in one pound fine bone black, and three eggs, and placed it over a slow fire; at 215° Fahrenheit took off a very dense, thick, green scum; when at 162° Fahrenheit it marked 7½° Beaumé.

A second parcel of juice from this grinding (three and a quarter gallons) was treated in the same manner, and set aside, both having been first boiled down to 22° Beaume.

Oct. 14, Temp. 8 A. M. 54°, noon 70°. N. W. clear. — Cut and ground fifty feet; eighty-one canes, produced seven and a quarter gallons juice, 10° Beaumé, which was treated as above, except that the eggs were omitted.

Oct. 15, Temp. 8 A. M. 50°, noon 70°. N. E. heavy rain. — Cut and ground fifty feet, produced eight and a quarter gallons juice, weighing 10° Beaumé.

Oct. 16, Temp. 8. A. M. 46°, noon 60°. N. W. stormy. — Cut and ground fifty feet, eighty-six canes, eight and three eighths gallons, 10° Beaumé.

The whole of the foregoing four parcels were at this stage of the process concentrated to 22° Beaumé, and set aside until I had completed the series on the 21st October; they were then collected together, and again clarified with eggs, and a second scum taken off; they were then again placed over the fire, and when at the temperature of 225° Fahrenheit, clear lime water in small quantities was added to coagulate the vegetable albumen, which is not disengaged at a lower temperature, but which is then observed as a whitish scum, very tenacious and glutinous, and is very detrimental to crystallization. After the various delays, heatings and re-heatings consequent on my limited means of working, (the great disadvantage of which, those acquainted with the subject only can appreciate,) I commenced filtering the whole, but found it so ropy and glutinous that it would not pass through; diluted it to 10° Beaumé, when it came through tolerably bright; then passed it through five feet of animal black; it parted with its coloring matter very freely.

Oct. 22, Temp. 8 A. M. 32°, noon 50°. S. W. clear. Divided the product into three parts, and boiled it as follows:

First part to 230° Fahrenheit. This stood an hour without crystallizing; found it too low, although the thumb and finger proof indicated otherwise.

Second part to 246° Fahrenheit; which was added to the first, and in a few minutes crystals began to appear.

Third part to 238°; being the mean of the other two. On finishing this, the two preceding had formed a thick, opaque mass of good crystals.

Filled one mould, weight 20 lbs.		
Weight of mould, - - $4\frac{3}{4}$		
	net weigbt $15\frac{1}{4}$ lbs.	
Filled one mould, - $14\frac{1}{2}$ lbs.		
Mould, - - - $4\frac{1}{2}$		
	" " 10 lbs.	
Total net weight, - - - - - - - -	$25\frac{1}{4}$ lbs.	

and next morning set them on pots to drain. Also boiled down the juice from the tops, four and three quarters gallons, which produced with the scum thirteen and a half pounds molasses.

Nov. 2, Temp. 8 A. M. 46°, noon 60°, S. W. clear. Knocked out the proceeds of this experiment with the following results, viz.:

1 mould, gross weight, 20 lbs.			
tare, $4\frac{3}{4}$ "			
net weigbt $15\frac{1}{4}$ lbs.			
weight of molasses, $8\frac{1}{4}$		Sugar.	Molasses.
	net weight 7 lbs.		$8\frac{1}{4}$ lbs.
1 " gross weight, $14\frac{1}{2}$ lbs.			
tare, $4\frac{1}{2}$ "			
net weight 10 lbs.			
weight of molasses, $5\frac{1}{2}$			
	net weight $4\frac{1}{2}$ lbs.		$5\frac{1}{2}$ lbs.
Add molasses made from tbe tops, as above,			$13\frac{1}{2}$ lbs.
Total weight of product of two hundred feet of a row,		lbs. 11.50	27.25
Fifty rows, four feet apart and two hundred and eighteen feet long, constitute an acre, and two hundred feet of a row is less than one fiftieth part of an acre by eighteen feet, therefore add pro rata,		1.03	2.45
Product of one fiftieth part of an acre in lbs.		12.53	29.70
Multiply by		50	50
Prodnct of an acre in lbs.		625.50	1485.00

A gallon of molasses weighs twelve pounds, therefore, divide 1485 by 12, and we have, gallons, 123.75.

For the acre $625\frac{1}{2}$ pounds sugar, and $123\frac{3}{4}$ gallons molasses, pro-

duced from 18,148 canes, yielding 1,737 gallons juice, weighing nine pounds per gallon, or 15,633 pounds, being four per cent. of sugar and 9.50 per cent. of molasses, or 13.50 per cent. together.

This sugar is of a yellowish brown color, about as dry as, and about the color of second quality Cuba sugar, such as is used by refiners. (See sample No. 2.)

THIRD EXPERIMENT.

Oct. 23, Temp. 8 A. M. 36°. M. 55°. Foggy.

The foregoing favorable progress induced me to make another trial, on a larger scale. The weather looked threatening, and as a precaution, I cut five hundred feet of canes, and stored it in the barn, to be used in quantities conforming to my means of working.

Nearly a month having elapsed since the first polariscopic observation was taken, and two weeks since the second practical experiment, having had several heavy white frosts, and three nights of ice, one eighth to three sixteenths of an inch in thickness, I concluded to have another examination by polarized light, to see the effect of these changes, when I was gratified to find the following results; juice weighing full 10° Beaumé:

First observation, right,	55°	
Add ten per cent for dilution,	5°.5	60°.5 right.
After inversion,	2°	
Add ten per cent as above,	0°.2	temperature 25° 2°.2 left.
Sum of inversion,		62°.7

This sum of inversion, (62°.7,) at temperature 25°, indicated 79.06 grammes of sugar per litre of juice; then,

As 204.24 : 18.82 :: 79.06 : 7.29 per cent. of sugar in the juice.

		Feet.	Canes.	Galls. juice.	
Oct. 24, Temp. 8 A. M. 54°, noon 60°. Fog and rain.	Ground	100	160	18¼	10° B
Oct. 26, Temp. 50°–60°. Heavy rain.	"	100	159	18¼	10° B.
Oct. 27, Temp. 46°–52°. Very stormy.	"	100	166	18 1-16	10° B.
Oct. 28, Temp. 40°–52°. Cloudy, N. W.	"	100	149	16¾	10° B.
Oct. 29, Temp. 43°–48°. Clear, N. E.	"	100	148	14⅞	10° B.

These several parcels were clarified like the second experiment, boiled to 15° and 18° Beaumé, and set aside till November 2d, when I found all but the last day's work had changed to a thick, liver-like mass, resembling good soft soap, very acid, and totally ruined. The last parcel, having stood a much shorter time than the rest, was but partially affected. It was boiled to proof, and crystallized very well.

I regret this misfortune less for the trouble it cost me than for the failure of the experiment, for it worked beautifully in the first stages, and the last grinding crystallized freely. The juice weighed heavier than previous or subsequent parcels, and would probably have produced better results. It taught me, however, the danger of delay, and also that no injury had been sustained by the juice so long as the canes remained unground, the last parcel having crystallized perfectly.

FOURTH EXPERIMENT.

Nov. 2, Temp. 38°–50°. N. E. clear. Since the 28th October, the weather has been mild and foggy, with heavy rains; temperature varying from 48° to 60°. A very decidedly increased development of sugar in the juice has been ascertained, viz.: 7.29 per cent., instead of five per cent., and I have gained some experience; so, instead of allowing the syrup to remain from four to twelve days, still containing a great portion of its fermentable impurities, gradually undergoing decomposition and depreciation, I remedy this evil to some extent, as will be seen. I also dispense with the fine ivory black and the filtering, thus simplifying the process.

Nov. 2, Temp. 38°–50°. N. E. clear. Cut and ground fifty-eight feet of a row, one hundred canes, the upper portions of the stalks turning yellow, leaves dead and dry; ground six and seven of the lower joints, produced ten gallons juice, weighing 10° Beaumé, much less acid than previous samples, and barely changing litmus paper, neutralized with milk of lime, and clarified at once perfectly with eggs, passed it immediately through three and a half feet black, and boiled it to 234° Fahrenheit; after standing an hour the crystals were large and sharp, but not very abundant till morning, it being boiled too low.

Nov. 4, Temp. 31°-50°. Ice. Cut and ground fifty-eight feet, one hundred canes, nine and fifteen sixteenths gallons, 10° Beaumé, rather more acid than the last, clarified it fully as above, passed it through five feet black, and set it aside, as it is clear and bright, and contains no feculent matter.

Nov. 5, Temp. 34°-62°. S. W. Cut and ground fifty-eight feet, ninety-four canes, nine and three quarter gallons, 10° Beaumé, treated as above, and set it aside.

Nov. 6, Temp. 50°-62°. S. cloudy. Weather changing, cut and ground fifty-eight feet, ninety-five canes, nine and five eighths gallons, 10° Beaumé, treated as above; also ground the tops of all the above 232 feet, which produced four gallons, two quarts, and three half pints of juice, weighing 12° Beaumé, more acid than the lower joints, treated it the same, boiled it to 238° Fahrenheit, and set it aside. In the morning I found a good crop of crystals, but the mass thick and viscid, added three tablespoonfuls clear lime water, heated it to enable me to pour it into a mould; gross weight nine and a half pounds, tare four and a half pounds, net five pounds. On the 13th knocked it out, and had three pounds good brown sugar, and two pounds molasses.

Nov. 7, Temp. 54°-66°. South. Boiled one half of the remainder of the proceeds of the above lower joints (one third of the whole having been boiled on the 2d, as above stated) to 236° Fahrenheit, and added it to that boiled on the 2d; boiled the other half to 237° Fahrenheit potted it at 176° Fahrenheit, very handsomely crystallized, and very light colored.

Nov. 8, Temp. 60°-74°. S. W. Withdrew the stops and set it on pots to drain.

Nov. 9, Temp. 34°-50°. S. W. The full mould (fifteen pounds size) had run one and one eighth gallons molasses, or syrup; if it had been boiled a little higher it would have produced more sugar, and less molasses.

Nov. 14, Temp. 30°-42°. N. E. Ice. The whole having now stood seven days, and being thoroughly drained, weighed as follows:

1 small mould, 10 lbs.		
Tare, $4\frac{1}{2}$		
net weight sugar, $5\frac{1}{2}$ lbs.		
1 larger " $18\frac{1}{4}$		
Tare, 7		
" "	$11\frac{1}{4}$	
Sugar from the tops,	8	
Product of 232 feet canes,	19.75 lbs.	
1 pot molasses, 17 lbs., tare 5 lbs.		12 lbs. net.
1 " " 9 " 5		4
1 " $12\frac{1}{2}$ " 5		7.25
Molasses from the tops,		2
Product of molasses from 232 feet canes,		25 25
236 feet are more than one fiftieth part of an acre by fourteen feet, therefore deduct pro rata - - - - - -	1.19	1·52
Product of one fiftieth part of an acre,	18.56	23.73
Multiply by - - - - - - -	50	50
Product of an acre in lbs. - - - -	928.00	1186.50
A gallon of molasses weighs 12 lbs., therefore divided by 12 for gallons,		98.87

and we have 928 pounds sugar (first returns) and 98.87 gallons molasses, made from one acre (18,277) of canes, which produced 1847 gallons juice, weighing at nine pounds per gallon, 16,623 pounds, or, sugar, first crop, 5.58 per cent., molasses, 7.14 per cent.; together, 12.72 per cent.*

This sugar is perfectly dry, as shown by Sample No. 4, it worked perfectly, and without the slightest difficulty, at every stage.

Nov. 17. Temp. 34°–48°. N. W. Boiled all the molasses from the above (except the two lbs. from the tops, which was too poor for recrystallization) 23.25 lbs.; added clear lime water until it marked 35° Beaumé when boiling; took off a thick, glutinous scum, and boiled it down to 243° Fahrenheit. In two hours it produced a copious crop of very good crystals. Allowed it to stand till morning, when it was quite solid.

Dec. 18. Temp. 30°–52°. S. E. Here an unfortunate accident occurred. Having placed the crystallized mass over a slow fire, to render it fluid enough to cast into a mould, I was called off to a case of illness, leaving it over the fire, and being detained much longer than I anticipated, on returning I found all the grain melted and the molasses boil-

* Neither the scales in which this juice was weighed, nor the quart measure in which it was measured were sufficiently delicate or accurate to give precise results, and as they form the basis of these calculations, the per centages are probably not absolutely exact, but they are sufficiently so for all practical purposes.

ing vehemently, and badly burned. Much discouraged, I however proceeded. It crystallized the second time, and was put into a mould.

December 20. Weighed the sugar from the 23.25 lbs. molasses boiled on the 17th November, as follows, viz.:

Gross weight,	11 lbs.
Tare,	4¼
Second crop of crystals from the 23.25 lbs. molasses,	6.25 lbs.
Deduct pro rata for the fourteen feet excess over one fiftieth of an acre,	.373
Second returns from one fiftieth of an acre,	5.877
Multiply by	50
Product of an acre from the molasses,	293.85

Then we have, as the whole final result of an acre of canes,

	Sugar.	Molasses.
1st returns,	928 lbs.	1186.50 lbs.
2d " (Sample IV.)	293.85	
And deduct molasses converted,		293.85
	1221.85	892.65
And 12 lbs. molasses per gallon gives		74.39 gal.

Say sugar, per acre, 1221.85 lbs.; molasses, per acre, 74.39 gallons; sugar, per cent., 7.35;* molasses, per cent., 5.37; sugar and molasses, 12.72 per cent.

I will repeat here, that, owing to the accident before stated, this sugar, (Sample No. IV.,) 2d returns, is not nearly of so good quality as it otherwise would have been.

FIFTH EXPERIMENT.

November 9. I must now mention that the last experiment was intended to have been on a considerably larger scale than those previous. Each day's work was, however, kept distinct and separate from the others, thus enabling me to determine it at any point.

Having thus proceeded to, and finished the clarification of the 4th parcel, (Nov. 8th,) and the weather becoming and continuing very warm, (thermometer as high as 74°,) I observed a very sudden and unfavorable change in the working of the juice. Instead of clarifying perfectly and with great facility, as at first, the defecation was dif-

* It may, perhaps, appear inconsistent to the casual observer, to find 7.35 per cent. of sugar obtained, when the juice only contained 7.29 per cent., as shown by the polariscope. This is readily explained. 1st. by the causes stated in a previous note; and 2d—the polariscope indicates pure sugar; whereas the sugar produced contains about four per cent. free moisture, and about three per cent. of molasses adhering to the crystals, also gum, &c., which would account for much more than the apparent excess.

ficult, the color many shades darker, the juice gradually fell off in weight from full 10° Beaumé to 9° Beaumé, and required ten feet of granulated black to bring it to the same color as that made six days previously with five feet black. I however proceeded (keeping this separate) to the crystallization.

Boiled it to 242° Fahrenheit, when it produced good, hard, sharp crystals; but finding the quantity, by measurement, had decreased very considerably, I took no further note on that head, but gave it white liquor until it was neat, (about the usual quantity,) and produced the sugar, (Sample No. 5,) being white sugar, directly from the cane, without refining or re-melting.

SIXTH EXPERIMENT.

November 27. Since the canes for the fourth and most successful experiment were cut, on the 6th inst., the weather has been very changeable. We have had warm Indian summer weather, with heavy rains, also very cold weather, making ice two inches in thickness—thermometer having varied from 16° to 60. To try the effect of these changes, I cut one hundredth part of an acre, which produced 11 15-16ths gallons of juice only, instead of nineteen or twenty gallons, as before. It had, however, regained its former weight of full 10° Beaumé, but was much more acid, rank, and dark colored than previously. It clarified without difficulty, but raised a much thicker and denser scum, and when concentrated, was very dark and molasses-like; it however produced good, hard, sharp crystals, but the quantity being much reduced, there was no inducement to pursue it further. This experiment proves, however, that this cane will withstand very great vicissitudes of weather, without the entire destruction of its saccharine properties.

SEVENTH EXPERIMENT.

Took the proceeds of the experiments that were considered failures, viz., all the third and the poorest portion of the second, viz.: thirty-four pounds very indifferent sugar; refined it in the open kettle, by the old process, and produced fifteen pounds loaf sugar, (Sample No. 7,) which is a very full yield for the quality used.

The foregoing are all actual results produced by myself, (the polariscopic observations having been taken on the spot, under the supervision of my partner, Mr. William Morris Davis) with no object in view but the truth, and a desire to contribute whatever useful information I could towards the solution of this interesting and important question. They are, I think, sufficiently flattering in themselves to warrant renewed exertions on the part of our agriculturists of the Northern and Middle States especially, and perhaps those of the South also, in the pursuit of this promising branch of industry, to the full and profitable development of which it is certainly capable, and which it is destined ultimately to attain—(as before mentioned they have been accomplished without the advantages of the powerful sugar mill, the vacuum pan, and the many other improved implements and apparatus now in general use in Louisiana and elsewhere) and they are also very important and interesting in many respects, not apparent to those unacquainted with the subject; it may therefore not be superfluous to make some further explanatory remarks:

1st. The mill used and the power employed in these experiments were much less efficient than those in general use on sugar plantations, and the waste proportionally greater; the loss from which causes I estimate at not less than ten per cent.

2d. It is well known to all who are acquainted with sugar and saccharine solutions, that, by frequent heatings and coolings, a considerable portion of the crystallizable is converted into uncrystallizable sugar, and is consequently lost as sugar. In these experiments every parcel was from necessity heated and re-heated from eight to twelve different times.

3d. It is impossible to produce as good results, whether as regards quantity or quality, from small as from large quantities.

4th. This sugar, (Sample No. 4,) is quite dry, and will lose comparatively nothing by drainage; the yield would be considerably greater, if it contained the usual quantity of footing that is contained in the hogshead when sold at the plantation, one of which being weighed there and re-weighed in Philadelphia, in the month of July, will be

found to have lost by drainage from 100 to 150 lbs., or from 10 to 15 per cent.

Assuming these propositions to be true, I make the following estimate of the probable yield of an acre of canes of ordinary growth, such as I have experimented upon, viz.:

Actual yield as per Experiment No. 4,		1221.85 lbs. sugar, 74 39 molasses.
Add for inefficiency of mill,	10 per cent.	
For heating and reheating, &c.,	5	
For footings, say but*	5	
	20 per cent.	244.37
Probable yield per acre,		lbs. 1466.22 sugar: galls. 74.39 molasses.

Further, it will be observed that my acre produced but 1847 gallons of juice. I have, however seen published accounts of far greater yield than this; one, for instance, in this county, apparently well authenticated, reaching 6,800 gallons per acre, which, according to my *actual* results, would produce 4499 lbs. of sugar, and 274 gallons molasses—and according to the foregoing *probable* results, would yield 5389 lbs. sugar, and 274 gallons to the acre. I do not pronounce such yield of juice impossible, but it will certainly be of rare occurrence—a mean between this and my yield would be a large return.

Another subject worthy of notice is the nature of the season. My impression is, that owing to the lateness and coldness of the spring, and the continued wet weather, the last has been quite an unfavorable season for the ripening and development of the sugar in the juice, to which cause I think a deficiency in the yield of at least ten per cent. may be attributed, which would further increase the quantity to 1612 lbs. of sugar, and 81 8-10 gallons molasses, a yield very nearly corresponding with that of the best conducted plantations of Louisiana, as will be seen by the following figures, which I have collated from a minute statement furnished to me by the enterprising proprietor of one of the most complete and costly establishments in that region, (it being furnished with vacuum pans, and all the most approved machinery of later times, and conducted under his own personal supervision,) of the actual product of one of his plantations of 266 acres,

* These two latter gains in sugar would be made at the expense of the molasses, taking from it the gain which would be realized by the use of a better mill, and therefore leaving the quantity of molasses unchanged.

for eight conseeutive years. These figures will also furnish useful data for the estimation of the cost of produetion here, viz.:

Aggregate yield of juiee from 266 acres for eight conseeutive years, ...	4,757,700 gallons.
Aggregate yield of sugar, ...	3,626;425 lbs.
" " molasses, ...	217,585 gallons.

COMPARISON.

LOUISIANA.	PENNSYLVANIA.
Yield of juice per acre,.....2,236 gals.	..... 1,847 gals.
Density of juice,(Beaumé) 8.44°	.....10°
Yield of sugar per gall. of juice,..0.76 lbs.	..... 0.66 lbs.
Yield of sugar per acre,.....1,704 "	Actual,.....1,221.85 lbs. Probable,.....1,612.00
Yield of molasses per acre,.....102 gals.	Actual,.....74.39 gals. Probable,.....81.83
Wood consumed per acre, 3.87 cords, at $2 50 per cord.	
Coal for engine, 0.41 tons at $2 50 per ton.	
Labor, per acre, 3.70 days.	

These details have been extended to a much greater length than was at first intended, but perhaps not beyond a useful limit for those interested. To the working farmer they may appear formidable and prolix; but he may, nevertheless, gain some grains of useful knowledge from them to repay for their perusal. The conelusions to be drawn from them will be seen by the following

SYNOPSIS.

1st. That it is obvious that there is a eulminating point in the development of the sugar in the eane, which is the best time for sugar making. This point or season I consider to be, when most if not all the seeds are ripe, and after several frosts; say wheu the temperature falls to 25° or 30° Fahrenheit.

2d. That frost, or even hard freezing, does not injure the juiee nor the sugar, but that warm Indian summer weather, after the frost and hard freezing, does injure them very materially, and reduces both quantity aud quality.

3d. That if the cane is cut and housed, or shocked in the field when in its most favorable condition, it will probably keep unchanged for a long time.

4th. That when the juice is obtained, the process should proceed continuously and without delay.

5th. That the clarification should be as perfect as possible by the time the density reaches 15° Beaumé, the syrup having the appearance of good brandy.

6th. That although eggs were used in these small experiments, on account of their convenience, bullock's blood, if to be had, is equally good, and the milk of lime alone will answer the purpose ; in the latter case, however, more constant and prolonged skimming will be required to produce a perfect clarification, which is highly important.

7th. That the concentration, or boiling down, after clarification, should be as rapid as possible without scorching, shallow evaporators being the best.

With these conditions secured, it is about as easy to make good sugar from the Chinese sugar cane as to make a pot of good mush, and much easier than to make a kettle of good apple butter.

INSTRUCTIONS *for the Domestic Manufacture of Sugar and Syrup, upon a small scale, from the Juice of the Sorgho, being a Practical Application of* J. S. LOVERING'S *Process.*

For the use of persons unacquainted with the subject, we commence with a brief statement of

GENERAL PRINCIPLES.

The juice of the ripe Sorgho is composed of

1. Crystallizable sugar, about seven and a quarter per cent.
2. Uncrystallizable molasses, about seven per cent.
3. Acid.
4. Vegetable mucilage, or gum.
5. Coloring matter.
6. Water.

Our object is to separate the sugar and molasses.

The acid and mucilage prevent the sugar from crystallizing.

1. Our first step will be to neutralize the acid in the juice by combining it with an alkali (lime).

2. Our second step will be to remove the mucilage by the addition of liquid albumen (blood, eggs, or milk) to the cold juice; we then apply heat; the albumen, being heated, coagulates, and, rising in the form of scum, carries the mucilage with it. This process is called *clarifying*, and should be *twice* repeated at least.

3. Having now got rid of the acid and most of the mucilage, our third step is to remove the *coloring matter*, by filtering the clarified juice through granulated bone black.

But a *peculiar mucilage* still remains, inseparable at a lower heat than about 225° Fahrenheit.

4. Our next step will be to boil the filtered juice to 225° Fahrenheit, and then to add lime water. This mucilage then rises as a scum, and is removed.

We now have left a solution composed of 1. Sugar. 2. Molasses. 3. Water.

5. To crystallize the sugar, we must evaporate the excess of water, by boiling. Most of the sugar will crystallize when the solution grows cold. The uncrystallized part, we drain off as molasses.

These operations require the greatest exactness, for

If we do not boil enough, the sugar contained in the solution will not crystallize when cold; or,

If we boil too much, the molasses will become so thick when it cools, as to impair the crystallizing of the sugar, and cannot be separated from it.

But how shall we know when to stop the boiling?

By the heat of the boiling liquid, as marked by the thermometer.

Pure water boils at 212 degrees of Fahrenheit's thermometer. You cannot make it hotter without changing it to *steam*.

The Sorgho juice, being a solution of about fourteen per cent. of sugar and molasses, &c., in water, becomes three degrees hotter before boiling, and boils at 215° Fahrenheit. As the water evaporates, a greater heat is required to keep the concentrated juice at a boil; in other words, the juice grows hotter and hotter. When it reaches the heat marked on the thermometer 238° Fahrenheit, there is just enough water left to enable the sugar to separate from the molasses when cold.

6. We now pour the concentrated juice into a mould, a keg, a barrel, or other deep vessel, with a plug in the bottom, and allow it to cool.

7. When quite cold (say in twenty-four hours), we remove the plug. The liquid portion, being molasses with a little sugar and water, gradually drains out, leaving the sugar dry in from four to ten days.

It is also important to remember

That the juice begins to ferment almost as soon as it leaves the cane, and therefore, should be neutralized, clarified, and boiled *without delay*. A very few hours' delay will spoil it.

A long continued exposure to heat gradually converts crystallizable sugar into uncrystallizable molasses, therefore, the evaporation should be *as rapid as possible*.

A concentrated solution of sugar and molasses is very liable to burn, and should, therefore, be carefully watched, and exposed to a *more and more moderate fire* as the evaporation advances.

The use of a saccharometer is to indicate the relative weight or density of a liquid as compared with water. This density depends upon the amount of sugar, or other heavy substances held in solution.

Consequently, the degree of density indicated by the saccharometer is an index of the proportion of sugar, &c., contained in the juice.

It is simply a hollow tube terminating in a bulb, loaded with shot, to keep the bulb down and the tube upright. Floating in pure water, the tube, at the point where it appears above the surface, marks 0. But in proportion as the liquid is heavier, the bulb does not sink so deep, and more of the tube appears above the surface. The density of the Sorgho juice, cold, is about 10° Beaumé, so called from Beaumé, the inventor.

If your kettles or moulds are of iron, give them two good coats of white paint *inside*, drying each coat thoroughly. This prevents the sugar from being made dark by contact with iron, which will be the case if the slightest acid be present. Before using them, scald them thoroughly *twice*, letting boiling water stand in them until cold, to remove the taste of the paint.

NECESSARY UTENSILS, MACHINERY, &c.

1. A thermometer *marking* 250° *Fahrenheit*. One without a case, or which can be removed from the case.

2. A saccharometer, or Pesè Sirop, scale of Beaumé.

You had better get *two of both the above*, to provide against accident.

3. A few sheets of litmus paper.

4. Two kettles of copper, brass, or iron, holding twenty-five gallons each; one of these may be smaller than the other, but if so, should be as large a diameter, only shallower.

5. Three, or more, large iron sugar moulds, holding twelve gallons each. If you cannot get the sugar moulds, three *long*, *narrow* twelve gallon kegs will answer.

6. Three five gallon pots of glazed earthen or stone ware, with mouths somewhat smaller than the caps of the sugar moulds. If you use kegs instead of moulds you can use pails instead of pots.

7. A barrel of granulated (not pulverized) bone black, such as is used by sugar refiners.

8. Four ten gallon tubs. (Two water-tight whiskey or cider barrels, sawed across the center, will answer.)

9. A yard of thick heavy bed ticking.

10. A circular piece of coarse wire gauze, to fit the inside of the sugar mould or keg, three inches above the lower end.

11. A circular piece of half inch board, full of gimblet holes, to fit the inside of the sugar mould or keg, three inches above the lower end.

12. A shallow perforated iron or tin skimmer.

13. A large iron or tin dipper, or ladle.

14. A sugar mill; if to work by hand, two parallel, horizontal iron rollers, set firmly in a frame, one eighth of an inch apart, and turned by a crank, with a spout to catch and collect the juice. If by horse power, three rollers set closer together, will be more effective. The greater the compression of the canes, the larger the yield of juice.

15. Two simple furnaces, or fire places of brick, upon which to place the two kettles. One larger furnace, with two holes, and one fire place under both kettles, will do, if the kettles are *movable*. But as the labor and delay of lifting them off and on is great, two separate arches are better. These furnaces must have a flue, communicating with a chimney, to create draft, and carry off the smoke.

16. A bushel of quick lime.

17. A gallon of fresh bullock's blood, or twelve dozen of eggs, or twelve quarts of milk. Either will do, but one of the first two is preferable.

PRELIMINARIES.

Having your mill ready, your furnaces built, your kettles and other utensils above described, on the spot; you will need two men, if you use a hand mill, to relieve each other at the crank, the one turning it, while the other passes the canes, one at a time, twice through the rollers, as you must work the mill without cessation throughout the day, to keep the kettles constantly supplied. If you use horse power, two boys will suffice, one to drive the horse, the other to pass the canes through, several at a time.

1. Provide abundant dry fuel, close at hand, and ready for immediate use.

2. Cut and deposit at the mill enough canes for the day's work, say ten canes for each gallon of juice required. Place two tubs (which we will call tubs 1 and 2) at the mill ready to receive the juice.

3. Prepare a bone black filter as follows:

Take one of the sugar moulds (which we will call mould No. 1). About three inches from the small end, fit into it the circular piece of half inch board full of small holes. Upon this, lay the circular piece of wire gauze; over the gauze lay a piece of heavy ticking (or blanket of several thicknesses), laying the edges carefully round the sides of the mould, so as to prevent the bone black from escaping; stop the hole at the small end of the mould, half fill the mould with hot water, then pour in as much bone black as the mould will hold, leaving about three inches of space on top. Set the filter, thus made, upon another of the tubs (which we will call tub No. 3), to serve as a cistern to receive the filtered juice. Or, a filter may be made of a tight keg or barrel, set on end, with a hole in the bottom, stopped with a plug or faucet, and having a wooden second, or false bottom, perforated with gimblet holes, three inches above the first; cover this with a piece of ticking or blanket, and on that put the bone black, as directed.

4. Prepare some *milk of lime* as follows:

Put about a gallon of quick lime into a pail, slacken it with water, until it resembles milk in appearance and consistency. Set it aside, and *stir it before using*.

5. Prepare some *lime water* as follows:

Put a gallon of quick lime into another pail, slacken it, fill up the pail with water, stir it thoroughly, let the lime settle. The clear water will be a saturated solution of lime, and is called lime water. *Do not stir this again*, but use it *clear*.

PROCESS OF MAKING THE SUGAR.

When the seeds of the Sorgho are at least three fourths ripe, or if in a cold climate, *when a hard frost has come*, cut your canes just above the ground, strip off the leaves and seed heads, and cut each cane into two parts, separating the eight lower joints from the upper ones. Lay aside the upper joints, which contain but little sugar, but will make good molasses.

Pass the lower joints through the rollers twice; let the juice flow into tubs 1 and 2. When about twenty gallons of juice are ready, put into one of the kettles, which we will call kettle No. 1, or *the clarifier*,

three gills of blood, or the whites of eight eggs, well beaten. If you have neither, two pints of milk will answer, but not so well. Add six tablespoonsful of milk of lime previously prepared, and stirred before using. Add about a gallon of juice, and stir the whole thoroughly together.

Now dip into one of the tubs of unmixed juice a small strip of the blue litmus paper. It will immediately turn red, more or less vivid in proportion to the acidity of the juice. Lay the strip of litmus paper aside, and add to kettle No 1 about nineteen gallons more of juice; stir the whole. Then dip the strip of reddened litmus paper into the kettle. If it again become blue, the acid is entirely neutralized. If not, continue to stir in milk of lime in small quantities, and to test with the litmus paper, until its original blue color is restored.

Now light a fire under kettle No. 1. As the juice grows hot a thick scum will rise. Do not disturb it, but bring the juice to a boil. To be sure that it does boil, remove a little of the scum with the skimmer, and insert your thermometer. When it marks 215° Fahrenheit, and the scum *begins to roll over,* put out the fire immediately, or remove the kettle. Let it stand ten or fifteen minutes. Then carefully remove the scum with the skimmer into a third pail. Then boil again.

When the saccharometer marks 15° Beaumé in the boiling juice, extinguish the fire, or remove the kettle, and let it cool to 160° Fahrenheit, or cooler. Now stir in six more eggs well beaten, or two gills of blood, or one pint of milk. *Omit the lime.* Again bring it to a boil, again extinguish the fire, or remove the kettle; and, after standing ten minutes, remove the scum as before. Then ladle the clear juice into the bone black filter, (see preliminaries No. 3,) having first withdrawn the stopper, allowing the warm water to flow out below, as the juice is poured in above, being careful to keep the filter full of liquid. When the water below begins to run sweet, marking 3° Beaumé, throw away what has previously run out, and receive the remainder in tub No. 3.

We are now ready to continue evaporation, and it will be better to do so in smaller quantities, as in a shallower mass the concentration will be more rapid. Therefore, when about ten gallons have passed

through the filter into tub 3, ladle into kettle No. 2, which now first comes into use, and which we will call the *Evaporator*. Boil to 225° Fahrenheit. Then put in a gill of clear lime water (see preliminaries No. 5). If a dirty white scum arises, skim it off, and continue to add a little more lime water every few minutes until no scum rises. Continue to boil to 238° Fahrenheit. If it boil over, put in a piece of butter the size of a walnut; then remove the kettle, or put out the fire, and pour into a tub which we will call No. 4.

By this time ten gallons more will have passed through the filter. Ladle it into kettle No. 2, which we have just emptied, boil to 225° Fahrenheit, clarify with lime water as before, boil to 238° Fahrenheit, and add it to the contents of tub No. 4, stirring the two together.

Previously, however, as soon as kettle No. 1 has been emptied upon the bone black filter, put into kettle No. 1 milk of lime and eggs, (or blood, or milk,) as before, and neutralize and clarify twenty gallons more of fresh juice from the mill, which has been grinding without interruption. This second charge of kettle No. 1 should be neutralized, tested with litmus paper, heated to 215° Fahrenheit, cooled, skimmed, boiled to 15° Beaumé, cooled again, a second time clarified with eggs, skimmed again, and passed through the filter; all this being done simultaneously with the filtering and evaporation of the first charge of kettle No. 1. It will then be put, in its turn, into kettle No. 2, now again empty, ten gallons at a time, boiled to 225° Fahrenheit, clarified a third time with lime water, skimmed, evaporated to 238° Fahrenheit, and added to the contents of tub No. 4.

While the second charge of kettle No. 1 is passing through the filter and kettle No. 2, a third charge of twenty gallons of fresh juice will be neutralized and clarified in kettle No. 1.

While the third charge from kettle No. 1 is passing through the filter and kettle No. 2, a fourth charge of twenty gallons of fresh juice will be neutralized and clarified in kettle No. 1, to follow the others, when boiled down to 238° Fahrenheit, into tub No. 4.

When as much juice as can be boiled the same day has been expressed, *stop the mill.*

Eighty gallons of juice clarified and boiled down to 238° Fahren-

heit will be reduced to something over twelve gallons, or enough to fill one of the sugar moulds.

When the day's boiling is completed, put the contents of tub No. 4 into a sugar mould or keg, having previously plugged the hole. Set it in a warm place, in no case colder than 60° Fahrenheit, if 70° or 80°, so much the better. This completes the day's work.

When cold, the next day, it will be a solid mass of crystallized sugar. Then withdraw the stopper, set the mould on an earthen pot or pail; in from four to seven days the molasses will have ceased to drain out; then turn over the mould upon a clean board or table, strike the rim smartly once or twice, and the sugar will slide from the mould in a solid mass. Break it up with a shovel, and it is fit for use. The contents of this mould should be from forty to fifty pounds of dry, yellow sugar, and about four gallons of excellent molasses will have dripped from it into the jar.

If preferred, the sugar making may here terminate; but, as the purifying power of the bone black filter is not yet exhausted, and as the whole labor and expense of preparation have been already incurred, it will be best to continue at least a second and third day.

SECOND DAY.

The process will be in all respects a repetition of the first day's work, and the result will be to fill an additional sugar mould or keg.

THIRD DAY.

The process will be a repetition of the above; but the filter being now exhausted, after the third day, it will be necessary to change the bone black. Before emptying the filter, or stopping the third day's work, however, pass cold water through the filter, which, so long as it runs sweet enough to mark 3° Beaumé, is to be added to the juice of the upper joints, of which we are about to speak.

MOLASSES.

At the close of the sugar making, pass through the mill the upper joints of the canes, previously laid aside. Add to the juice the liquid portion of the scum in third pail, together with the washings of the

filter, of tub No. 4, and of other utensils. Neutralize the acid with milk of lime, and test with litmus paper as before. Clarify twice with eggs, (or blood, or milk,) but omit, if preferred, the filtering through bone black. Boil finally only to 228° Fahrenheit, instead of 238° Fahrenheit, as for sugar.

The product, when cool, will be about eighteen gallons of excellent syrup. From three days' work, of two hundred and forty gallons of juice—from say two thousand canes—in all there should be a total product of about one hundred and twenty-five pounds to one hundred and fifty pounds of sugar, and twenty-seven gallons molasses.

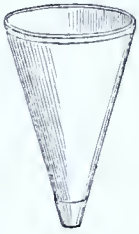
This operation being on a very small scale, and with a hand mill, is carried on under great disadvantages. The same labor on a larger scale would produce much greater results. The process and routine here given will answer for larger operations. It would be better, however, especially if the quantity is increased, to have the second or evaporating kettle of greater length and breadth, and as shallow as possible to expedite the evaporation. A larger and longer bone black filter will also be needed.

Either sugar or molasses of good quality, but of darker color, may be made by the above process, omitting the bone black. If it be desired to make syrup only, stop the boiling at 228° Fahrenheit.

If white sugar is desired, the following additional process will be necessary. On the third day after the sugar has been put into the moulds, the greater part of the molasses having drained from it, scrape off, with a knife, the crust on top of the sugar, leaving a smooth granulated surface, hollowing a little to the center. Moisten the scrapings with cold water into a thin paste, and replace them on the sugar. Next day dissolve enough refined sugar, the whiter the better, in six quarts of water, to make a solution marking, when boiling hot, 32° Beaumé. Pour one inch in depth of this solution, cold, on top of the sugar. On each of the two following days, put on a similar quantity. After the sugar ceases to drain, knock out the loaf; the upper portion will be white, the lower part light yellow. Divide the loaf and crush each portion separately.

If by any mistake, or carelessness, by burning or overboiling, or by

the immaturity of the canes, the molasses does not begin to drain from the mould on the second or third day, run an awl, a large nail, or other sharp iron instrument, into the hole at the foot of the mould some two or three inches, and then withdraw it. If, after ten days longer in the warmest place you have, it still fails to run, put the contents into a kettle, add a little water, heat it to 228° Fahrenheit, and it will make good syrup.



SUGAR MOULD.

DRAINING POT.

MOULD AND POT.

AMERICAN NOTES FOR 1857

ON THE IMPHEE.

The history of the introduction of the imphee into the United States has substantially been given in the historical portion of Part I. That it may be perfectly understood I will make a condensed statement in this place. Mr. Wray arrived in this country in the month of March last, bringing with him seed of each of his varieties of imphee, and samples of alcohol and sugars made from them. The greater part of the seed he planted upon the estate of Governor J. H. Hammond, of South Carolina; but portions were put under cultivation by Mr. R. Peters and Mr. J. Eve, of Georgia; Brutus J. Clay, of Kentucky; a gentleman in Canada; and Mr. D. Jay Browne, of the United States Patent Office. Of all these lots, the only one from which any considerable part of the crop was saved was that of Mr. Hammond. In Canada the seed did not ripen, Mr. Browne's lot but partially, that of Mr. Peters and of Mr. Eve were entirely mixed with durra* corn, and consequently not saved. Of Mr. Clay's I give the account published by himself. (Page 37.) The imphee seed brought by Mr. Wray was grown for him by the Count de Beauregard, on his estate at Hyéres, France, and was there packed and shipped direct to America. By some chance a large quantity of the seed of durra was sent mixed with the imphee, and was unsuspectingly distributed by Mr. Wray to his several partners in the adventure here. At Governor Hammond's urgent solicitation, Mr. Wray sorted out enough seed to plant several acres of some ten or more of the choicest varieties, and these were planted separate and apart from each other. The remainder, over one hundred acres, was planted with the seed just as sent from France. The result was that before the time of ripening, to their great dismay they discovered that it would be necessary to sacri-

* The word *durra* has been spelt dourah, dhurra, doura and dourrha by various writers. In the preceding pages I have adopted the spelling doura; and Mr. Wray, I perceive, has done likewise. The encyclopedias of Loudon, Johnson, and Hooker, make no mention whatever of the plant; but Noah Webster, in his dictionary, spells it *durra*, and as this is nearest to the Arabic derivative, and more correct on phonetic principles, I shall in future adopt it.

fice some *six thousand five hundred bushels* of this precious seed, and the only crop which could with safety be disseminated, and conscientiously recommended by Governor Hammond, was that harvested on the assorted acres of the ten or more best varieties. The crop of Mr. Peters was utterly ruined, as he had not taken the precaution to select and plant separately. Before making arrangements with Mr. Wray, he had imported directly from Vilmorin, Andrieux & Co., of Paris, about fifteen pounds of what was supposed to be a variety of imphee named Vim-bis-chu-a-pa, at a cost of $10 per pound; but this turned out to be nothing but worthless durra.

With that generosity which characterizes him, General Hammond declined receiving any share of the profits from the sale of the seed, and presented to Mr. Wray the entire crop of the pure seed, amounting to about four hundred bushels.

To inform myself particularly as to the success of this first cultivation of the imphee, and to assist in making sugar from it, I visited in October of 1857 the plantations of General Hammond, Mr. Peters, and Mr. Eve. A part of the imphees I found mixed as above stated. On the separate lots I could see no signs of a hybridation with durra; but on one or two there were straggling plants of some variety of imphee, the seeds of which resembled those of the lot with which it was mingled. The appearance of the various plants is truthfully given by Mr. Wray. Of the comparative amounts of sugar which they are capable of yielding I cannot speak, for our attempts to produce it were not successful

It is comparatively an easy thing for northern and western farmers, living adjacent to lines of railroad, to provide themselves with any sort of machinery or apparatus at a moment's notice; and, if breakages occur during their operations, a competent mechanic is speedily found to repair them. But such is not the case on an inland southern plantation; and hence it resulted at Governor Hammond's that, what with the novelty of the operations, breakages of the mill and steam engine, quarrels of mechanics, the late arrival of Mr. Wray with his seed, and other things combined, no attempt was made to "commence crop," to use the West Indian phrase, until the canes were considerably past

maturity; and, after operations were commenced, breakages and accidents caused great confusion in the work, and fatal delays. Besides this, the canes were grown upon a reclaimed swamp, thoroughly drained, and so rich in soluble saline matters, that the crop of corn on an adjacent lot was, on one measured acre, one hundred and eight bushels. Those who have read my remarks upon the pernicious influence upon the crystallization of sugar, of soluble mineral matters taken up by the cane juice, will not be surprised to learn that, although the train worked in the most satisfactory manner, and the boiling was superintended by a negro sugar maker from Florida, no crystallization of imphee juice could be obtained.

Mr. Wray found that the proportion of salts of iron was so great in the juice, that the single trial we made with nut galls gave us a liquid nearly as black as ink. Suffice it to say that the sugar was not made: but, as will be seen subsequently, it was not because crystallized sugar does not exist in the imphee.

Governor Hammond, failing to produce sugar, turned his whole attention to the manufacture of syrup; of which he made from the imphee exactly three thousand gallons, which will be entirely consumed on his own estate.

With Governor Hammond and Mr. Wray I frequently tested the juice by the saccharometer. In one case the juice of the Boo-e-a-na I found to be 10½° Beaume, which it will be remembered indicates no less than nineteen per cent. of sugar in the juice. I am convinced that on favorable soils, and in suitable climates, the juice of the imphee will mark nearly if not quite as high a saccharine richness as the *Saccharum officinarum*, or tropical sugar cane.

Judging from my observation, the imphee is more succulent than the sorgho. An experiment was made with ten stalks each of sorgho and imphee, to test the respective quantities of juice. The result was that the imphee gave sixteen pints, or two gallons; sorgho gave eleven pints; a very large per centage in favor of imphee. Imphee starts off more rapidly in its spring growth, and will be valuable on that account for northern latitudes. Many of the imphees have also a larger stalk than the sorgho, and smaller seed heads, or panicles, and

will not only give more juice for distillation and sugar making, but will not so readily be prostrated by the winds of our western prairies. The outer covering of the imphee stalk is thinner than that of sorgho, and is consequently easier to crush in the mill.

Frequent allusion is made in the preceding pages of this work to the practice of cutting off the seed heads to increase the secretion of sugar. I saw many stalks at Mr. Peters' thus treated, which had been utterly ruined. The energy of the plant is so great, that when its forces were diverted from the elaboration of starch in the seeds, the butt at each joint of the stalk threw out short stems, which attained a length of some eighteen inches, and attempted to produce miniature seed heads. The result was, that the vitality which would in the natural course of growth have produced a perfect plant, with a full crop of ripe seed, was exhausted in the production of monstrosities. It is sufficiently well attested that the ripening of the seed does not interfere with a maximum yield of sugar.

Mr. Peters found that sorgho planted on the 15th March ripened within a week of that planted on the 15th May. He had some imphee ripening which had been planted only ninety days.

On Governor Hammond's place the Boom-vwa-na and Nee-a-za-na ripened the earliest. The former grows to a height of eleven feet, but the latter only seven. This brevity of stalk is, however, compensated for by the number of suckers which grow from the stool. The Oom-se-a-na and En-ya-ma were thought to be best for syrup making. The Koom-ba-na grows about ten feet high, and is very excellent. A new variety, the Sorgho-ka-baie, promises to be very excellent. I should be willing to plant, to a moderate extent, any one of eight or ten varieties which were saved by Mr. Wray, and sold to Mr. Moore.

NEWS OF THE IMPHEE FROM AFRICA.

In the month of September last there appeared in the New York *Journal of Commerce* a letter from Rev. H. A. Wilder, an American missionary at Umtwalume, in Caffraria, in which Mr. Wilder states, that considerable quantities of excellent sugar have been made from

imphee in that colony during the past year. He also says that he sent a small amount of the seeds to friends in this country some three years ago; but that nothing had resulted from it.

I have had further intelligence of the manufacture of imphee sugar in Caffraria by Mr. Wray, from Mr. Charles H. Caldcott, a merchant of Port Natal, who is at present in New York. This gentleman informs me that he both saw and tasted imphee sugar in the colony, and that it does not differ from the sugar made from the ordinary cane.

RESEARCHES OF DR. JACKSON.

At the recent meeting of the United States Agricultural Society at Washington, January 13th, 1858, Dr. Charles T. Jackson being called upon to give his testimony upon the capability of the imphee to produce sugar, stated, that he had been employed by the United States Patent Office to make experiments upon both sorgho and imphee. Seed heads and stalks of imphee had been sent him for examination by Mr. Browne, of the Patent Office; he had given them minute study, and had sent in an official report to the government. The juice of imphee would give nine per cent. of true cane sugar, and six per cent. additional of *glucose*. It would give twelve per cent. of alcohol or proof spirits, which was peculiarly suitable for the manufacture of brandy, because of an agreeable aroma which it contained. This very large yield of alcohol which it and the sorgho would afford, would materially affect a very important interest. Three fourths of the alcohol made in Massachusetts last year was consumed in the manufacture of burning fluids, and in mechanical and chemical operations; and if these plants can afford us a readier and cheaper supply of alcohol than the cereals it is a very strong recommendation for their culture. His official report will be found in the next Report of the United States Patent Office.

The following letters, from Governor Hammond to Mr. Wray, will fully explain his estimate of the value of the imphee.

LETTERS FROM GOV. HAMMOND.

"DEAR SIR— "REDCLIFFE, November 26th, 1857.

"I received to-day, the *Southern Cultivator* for December. It contains two letters from Mons. Vilmorin, denouncing your imphees in a manner that appears to me *malicious;* and, as I know his statements are false as regards the imphee grown in this latitude, I deem it due to truth and to you, to give my testimony against them. Your imphee came here too late to allow a perfectly satisfactory comparison to be instituted between that and sorgho. But I do not remember that in any attempt we made to compare them. the results were in favor of the sorgho. Certainly, most of the varieties of imphee have a larger stalk and produce more juice; none, I believe, are smaller. As to 'red rot,' which so seriously affected the sorgho, I do not think it appeared at all in more than one kind of imphee, and that had ripened long before we reached it in our operations. I am sure the imphee is not *more* subject to the 'red rot,' than the sorgho, and was not *so much* affected by it this year here. As to the per centage of saccharine matter in the juice, I saw the saccharometer mark eighteen once, and frequently fourteen to sixteen per cent. I believe the sorgho never reached seventeen per cent.

"From my experience of this year, I should be unwilling to say that the imphee is decidedly superior to the sorgho. But I am equally unprepared to say that any single variety of imphee is inferior to the sorgho. I shall try all of them again and again before I determine which is the very best.

"As you say Mr. Vilmorin obtained no pure imphee seed from you, I am inclined to think he has not made his expiriments with *pure* seed. Certainly the seed he sent to this country last spring for imphee, at $10 per *pound*, was thoroughly mixed with durra corn; and one parcel that he sent as Vim-bis-ehu-a-pa, was *all* durra, as I am informed.

"I have not, as you well know, any interest in the sale of imphee seed, or anything made from imphee, and you are well aware of my aversion to having my name in the papers, but you can show this letter to any one you please, and, if absolutely necessary, publish it. I shall probably put the substance in the next *Cultivator*. Yours very truly,

"L. WRAY, Esq." "J. H. HAMMOND.

The following is an extract from a letter to the publisher from Gov. Hammond, in answer to a request that he would give his opinion as to the value of the different varieties of imphee.

"WASHINGTON, D. C., January 13th, 1858.

" * * * I think these seeds well worth distributing. They produce a sugar cane at least equal to the sorgho in all respects, and some of them are twice the size. I am inclined to think we shall ultimately find several of them (ripening at different periods,) superseding the sorgho altogether.

"I plant sixty acres of the cane this year—of these, four will be planted in sorgho, and the remainder in imphee. * * *

(Signed) "J. H. HAMMOND."

LETTER FROM HON. BRUTUS J. CLAY.

"PARIS, KY., November 23d, 1857.

"DEAR SIR—

"I planted imphee on the 23d day of May last. I broke the ground twice, and planted the hills three by four feet apart, two and three seeds in a hill; about three fourths of it grew, hence it was rather thin on the ground. It did not well mature before frost; the middle of October.

"I think the average product of stalk was no more than eight feet. They were, however, one third larger than the sorgho, and contained *much more juice*, of a quality very similar to that of the latter. It stood up well, large at the bottom and tapers to the top: *is not liable to be blown down by the wind.*

"The sorgho I planted about the 13th of May. It came up well, producing stalks small and slender, ten to twelve feet high, *very apt to be blown down by the wind;* but this and the imphee require a little more care than corn.

"Of the two varieties of cane, I think the imphee will prove the most valuable plant; if planted earlier and upon a good soil, with a southern exposure, I think it will ripen before frosts. The past season has been a bad one for a fair experiment; even our corn is not yet dry enough to grind for bread, it has been so backward and late.

"Yours, &c.

"ISAAC A. HEDGES, Esq." "BRUTUS J. CLAY.

Despite the unfortunate result of the attempts to make sugar on Governor Hammond's place, and the mixture of durra corn with all of the immense crop of imphee seed, which otherwise would have immmediately supplied the country, which, from the few hundred bushels saved pure by Mr. Wray, can only be accomplished in one or two years, I think my readers will see in the facts above set forth reason to believe that the year has not been entirely unproductive in results, nor without a great promise for the future cultivation of the imphee.